

Lessons Relearned

FROM THE INCEPTION OF the United States, civilian surgeons have been involved in advising the military and providing surgical care for the wounded soldier. John Jones, professor of surgery at King's College in New York City, is the most notable of those who served during the Revolutionary War. Others included William Shippen, James Tilton, Samuel Bard, William Baynham, Thomas Bond, John Bard, James Lloyd, and John Warren. Many of these surgeons had studied under William and John Hunter in London, England. One of the remarkable contributions of civilian medicine to military surgery was during the Civil War by the US Sanitary Commission. Although initially criticized, by the end of the war it was recognized as contributing significantly to decreased mortality of the wounded. Another significant contribution during the Civil War was accomplished by Surgeon General William Hammond after Gettysburg. In cooperation with state governors, he established a reserve medical corps, and the medical competence had to be vouched for by local authorities. This proved to be effective during the Battle of the Wilderness. The reserve physicians primarily changed dressings, treated sick soldiers, and helped run the field hospital; amputations and other complicated surgical procedures were left to regular army surgeons who were thought to have greater skills with the knife.

This concept of consultant surgeons was important during World War I and was particularly important during World War II. An exemplary example was Edward Churchill, who was appointed chief surgical consultant to the North African–Mediterranean Field of Operation. Among his many suggested improvements for care was his observation shortly after arriv-

ing in North Africa that plasma was not a good substitute for blood. He went directly to the surgeon general but his advice was not heeded. Undeterred, he put his professional reputation on the line by going to the *New York Times* and writing an editorial on the absence of blood and its deleterious effect on wounded soldiers. Blood was soon made available, with an obvious improvement in outcomes of wounded soldiers. Civilian consultants also served during the Korean War and Vietnam War, but, unfortunately, none were appointed during Desert Storm.

Following Desert Storm, there were several reports from the US General Accounting Office¹⁻³ that documented problems with medical shortage and medical capability. These were confirmed by one of us.⁴ The 4 general categories outlined by the US General Accounting Office report were mobilization and deployment of medical personnel, problems with medical supplies, doctrinal employment of hospitals, and problems with patient evaluations and regulations. The US General Accounting Office report also documented that many personnel were either incompletely trained or untrained for wartime missions. During Desert Storm, there were 2 other issues that bear on our current conflicts in Afghanistan (Operation Enduring Freedom) and Iraq (Operation Iraqi Freedom). The first is evacuation of troops. The US General Accounting Office found that air evacuation support during Desert Storm was neither adequate nor responsive, particularly at night. Part of this was fear of the threat posed by surface-to-air missiles in the desert. In addition, some of the helicopters were unable to perform night missions or missions in bad weather because of inadequate navigational systems. This difficulty with the evacuation system seemed to have

extended into evacuation from the theater. The relationship of the single general hospital in theater with the Air Force was strained at best. There seemed to be contention between services regarding roles, responsibility, and equipment. The end result was a poorly responsive system. Thus, the 50th General Hospital (US Army) had to give up its ventilators, nurses, and physicians to accompany the critically injured back to Germany onboard a US Air Force aircraft. In addition, other Air Force assets located in Europe were not brought into the theater to help with the evacuation process. Fortunately, only a few soldiers required evacuation.

The second issue was research in the theater. The commanding general had issued an edict that research would not be done in the theater. This edict may have been because of his known antipathy to medical personnel, which had been demonstrated at a commencement address at Madigan Army General Hospital, Tacoma, Washington, when he was a commander at Fort Lewis in Washington. This decision was particularly detrimental because the military had been doing extensive research on various fluid resuscitation regimens and a treatment for septic shock.

In the 2 years between Desert Storm and the war in Somalia, the Department of Defense was slow to make changes and improvements in combat casualty care. There were similar problems with evacuation to Germany of casualties from Somalia.^{5,6} Subsequent to the war in Somalia, major changes were undertaken by the medical corps of all 3 services.^{7,8} Training sites were established with leading civilian trauma centers, and evacuation teams were organized.⁹ Many changes have occurred in trauma care within the Department of Defense, many of which were summa-

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rized by one of us in the American Association for the Surgery of Trauma Fitts Lecture.¹⁰ To assess these changes and subsequent care and to share expertise, the military, in concert with the American Association for the Surgery of Trauma and the American College of Surgeons Committee on Trauma, has sent senior trauma surgeons to spend time at Landstuhl Regional Medical Center (LRMC) in Germany as consultants to help with the surgical care and to evaluate the care of patients coming from Afghanistan and Iraq. So far, the Senior Visiting Surgeon (SVS) Program has worked well, and the SVS are unanimous in the excellence of urgent care and evacuation.

During the past 2 years, a number of civilian trauma surgeons, some with previous wartime service, have been working with military surgeons to address input to our current medical care system serving the wounded soldiers in conflicts in Afghanistan (Operation Enduring Freedom) and Iraq (Operation Iraqi Freedom). The concept of an SVS Program was a process initially conceived by senior members of the military medical corps of the US Army and Air Force. A proposal outlining the SVS Program was presented to the Executive Committee of the American College of Surgeons' Committee on Trauma and the service's surgeon general. Following endorsement of this group, the SVS Program received support and endorsement from the American College of Surgeons and the American Association for the Surgery of Trauma. Key figures supporting this program included Drs Thomas Russell, C. William Schwab, Andrew Peitzman, Wayne Meredith, and Peggy Knudson. In brief, the SVS Program was developed to afford senior leaders in US trauma surgery the opportunity to travel to LRMC to observe and actively participate in the care of wounded soldiers evacuated from the theater of operations in Iraq and Afghanistan. The SVS Program consists of a 2- to 4-week rotation, during which the SVS participant actively engages in patient care, daily rounds, didactic lectures, and performance improvement initiatives. In addition,

the SVS members serve as "consultants/mentors" to the physicians and care providers at LRMC, to develop research initiatives and peer-reviewed publications. The following observations are based on the recent experience of one of us (D.D.T.) as an SVS at LRMC.

The types of wounds being treated by the military medic are of a magnitude rarely seen. The body armor clearly helps, but the devastating effects of explosions usually cause multiple penetrating injuries to the brain, lungs, and viscera. Compartment syndrome is extremely common. The penetrating trauma can be high-velocity weapons, fragments, rocks, bolts, nails, or any other sharp objects placed into improvised explosive devices. The wounds are contaminated with dirt and whatever objects are used. The soil and water have *Acinetobacter*, and it can be a resistant organism, although mortality is not increased by this organism.⁹

In-theater care is remarkable. Evacuation of the wounded soldiers is handled by state-of-the-art helicopters and ground tactical ambulances with well-trained personnel.^{11,12} Once they reach a Forward Surgical Unit (forward surgical team/Expeditionary Medical Support) or a higher level of care, resuscitation is equally remarkable, and treatment is focused on decreasing the major potentially preventable cause of death on the battlefield, truncal hemorrhage. State-of-the-art massive transfusion protocol data support the use of whole blood transfusion.¹³ Factor VII is available and widely used. It is not unusual to see resuscitations in which 40 or more units of blood have been used. Damage control surgical techniques are used in approximately 30% of cases, including injuries to the abdomen and extremity vascular injuries. Intravascular shunts are used temporarily, and external fixation of open fractures is the gold standard.^{14,15} Fasciotomies are common, not only in patients with burns but also in patients with explosion injuries. Burns of more than 50% total body surface area are common. These patients are given priority evacuation to LRMC and then rapidly moved to the Brooke Army Medical Center

Burn Unit (San Antonio, Texas) within 24 hours of their injuries. Burn protocols and resuscitation flowcharts that cover 72 hours, involving 3 to 5 hospitals over 3 continents, are used and have been instrumental in decreasing overresuscitation and a high incidence of secondary abdominal compartment syndrome.¹⁶ This type of performance improvement project represents the best aspects of a maturing trauma system.

Fortunately, the Department of Defense has once again allowed research to be accomplished in the theater, as it was in most previous wars. A 6-person team led by a physician has just finished its first rotation in Baghdad. This allows surgeons and physicians to investigate new therapies and apply them to the maximum benefit of the casualty. Hemostatic wound dressings, changes in body armor, genetically engineered coagulation factors, and new burn wound dressings are examples of their efforts. Modern computed tomographic scanners, portable ultrasonographic machines, and handheld blood analyzers are all examples of the state-of-the-art equipment the military has placed in the theater.

One of the more remarkable changes is the evacuation of wounded soldiers from the theater of operation (Iraq and Afghanistan). This is done typically with aircraft of opportunity (C-17, C-130, and others) and falls under the rubric of Critical Care Air Transport. Physicians and surgeons with critical care boards head up the team. Critical care nurses complement the physician care.^{17,18} The third member of the Critical Care Air Transport team is a respiratory therapist. The Critical Care Air Transport team carries its own equipment and is capable of supporting 3 patients receiving mechanical ventilation and/or a total mission of 6 critically ill patients. Ventilators and life support mechanisms again are state-of-the-art, and it is rare to have death in flight.

Once the patient reaches LRMC, the critically injured are sent immediately to the critical care unit, bypassing the emergency department. A team of surgeons and physicians spends 4 to 5 hours per

patient getting the patient admitted, and care is made seamless during this period. The integrated use of e-mail, digital pictures, and Web-based patient information systems has improved the flow of information regarding incoming casualties. One concept that stands out through all of this is "team effort." The team consists of not only the critical care physicians and surgeons but also gastroenterologists, infectious disease consultants, radiologists, and psychiatrists. The patients' families are contacted and given up-to-date progress of the wounded soldier. Civilian contractors are often cared for at LRMC and then repatriated back to the countries from where they came.

One of the more progressive concepts that has been established at LRMC is the theaterwide mortality and morbidity conference on Thursday afternoon. This is a televised/networked conference involving medical care facilities in Afghanistan, Iraq, Landstuhl, and the numerous military-receiving hospitals in the United States. This is a no-holds-barred positive and constructive mortality and morbidity conference with feedback from surgeons who cared for the individuals in the theater. Care at LRMC is discussed, as is subsequent care at Bethesda Navy Medical Center and Walter Reed Army Medical Center in Washington DC, and Brooke Army Medical Center.

In summary, the military has made a remarkable change in evacuation of casualties from the theater of war to stateside hospitals. The overall case fatality rate is the lowest in any war we have ever been in.^{19,20} The initial surgical care represents state-of-the-art trauma care, including resuscitation and damage control care. Critical care be-

gins immediately postoperatively and is provided in a seamless fashion during evacuation, either to Landstuhl or from Landstuhl to the continental United States. New techniques being developed in this war will once again improve care in the civilian community. Notably, the military can provide immediate benefit for disaster medical planning and care after natural disasters and acts of terrorism.

Overall, urgent care for our soldiers is superlative and second to none. The physicians, nurses, and medics who provide this care deserve our gratitude.

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